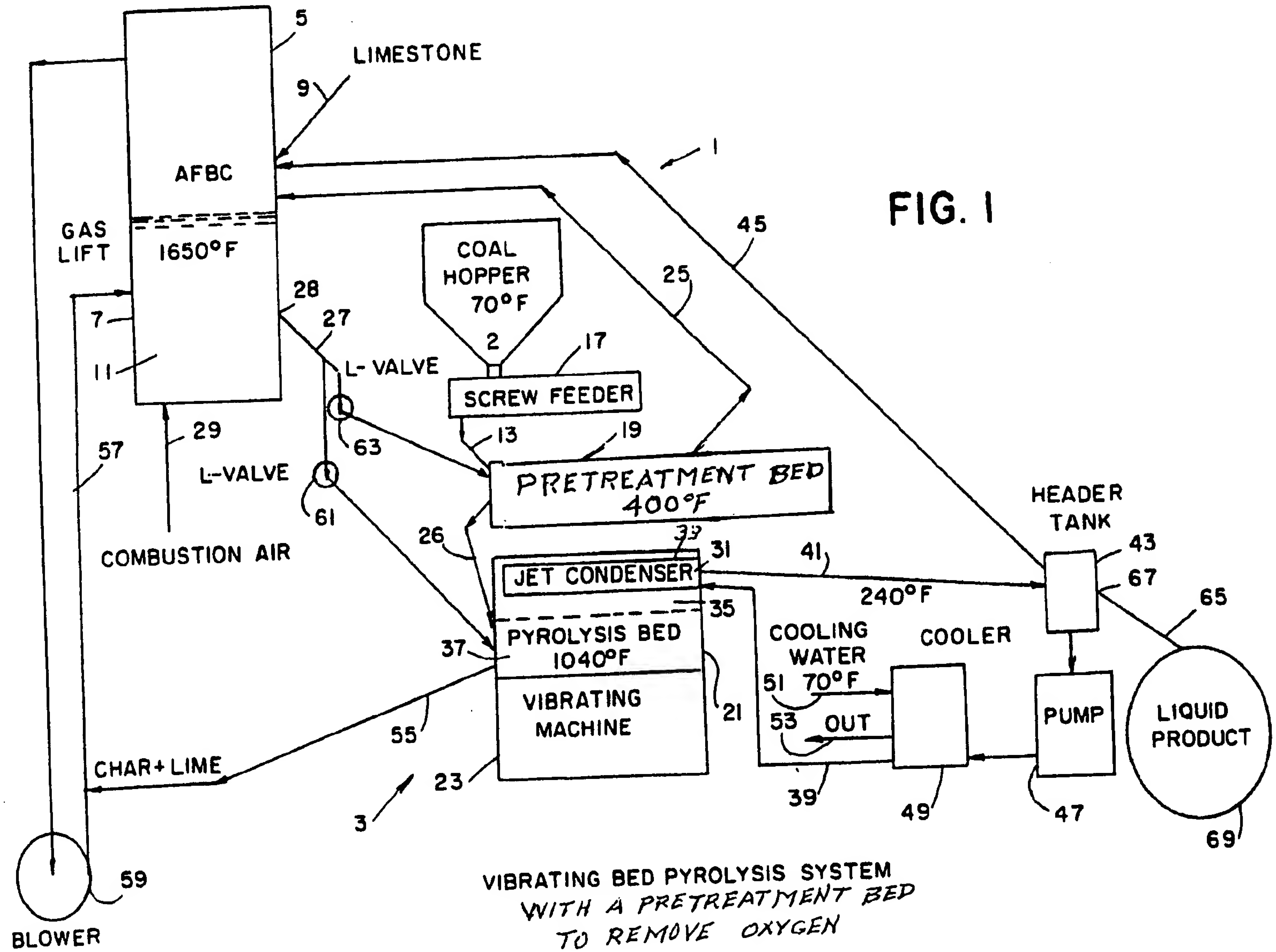


FIG. 1

VIBRATING BED PYROLYSIS SYSTEM
WITH A PRETREATMENT BED
TO REMOVE OXYGEN

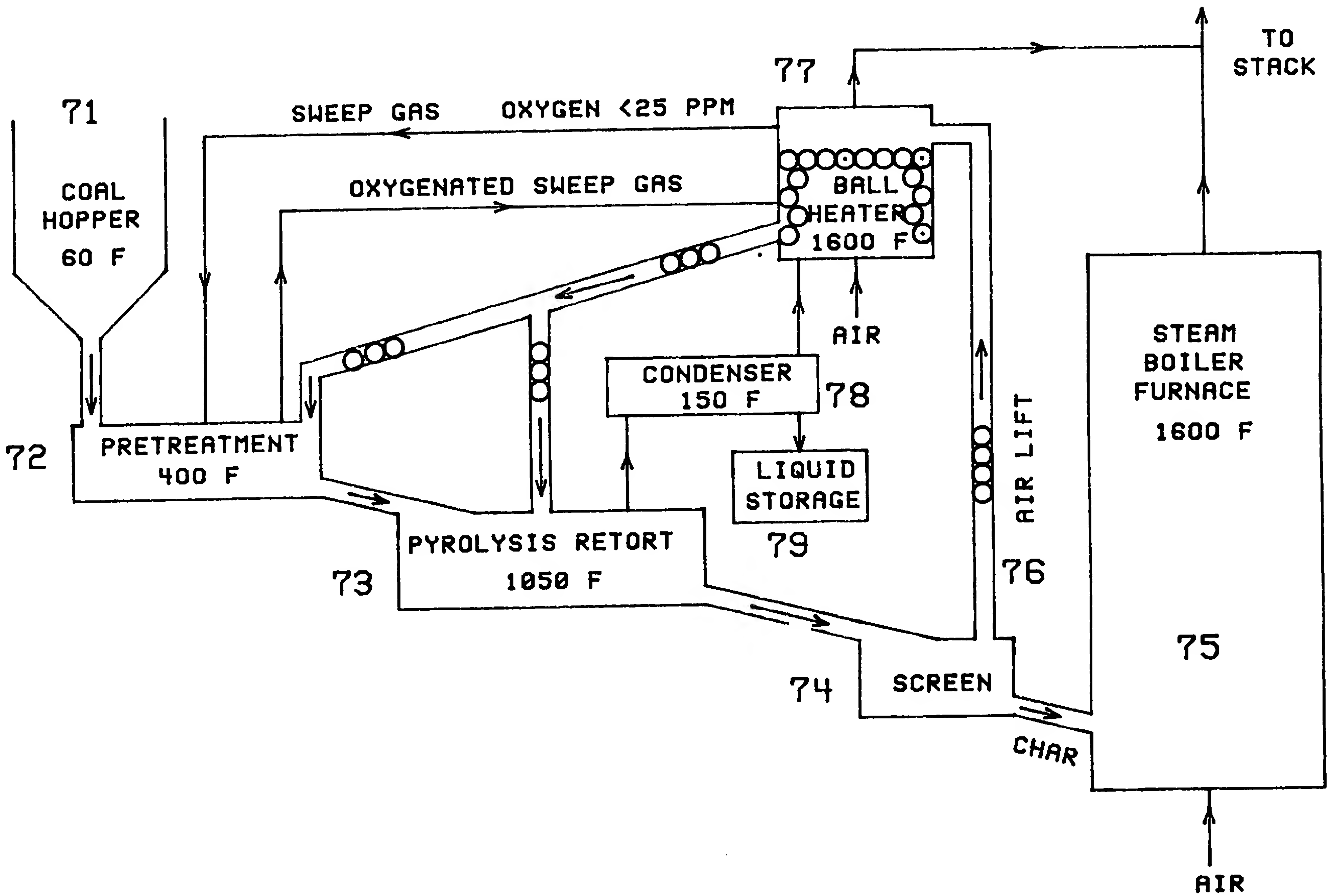
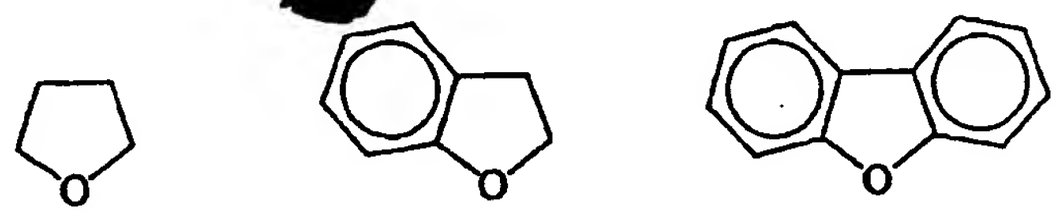
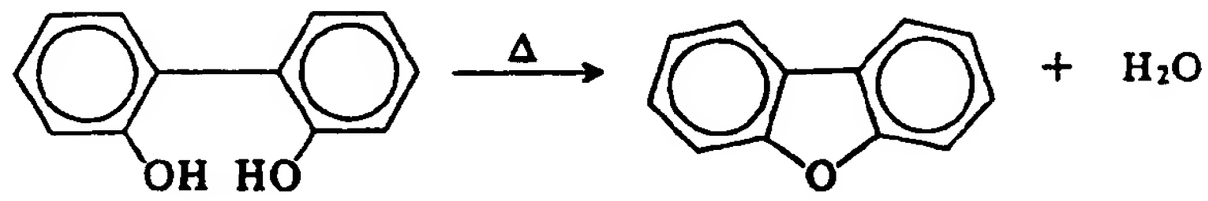


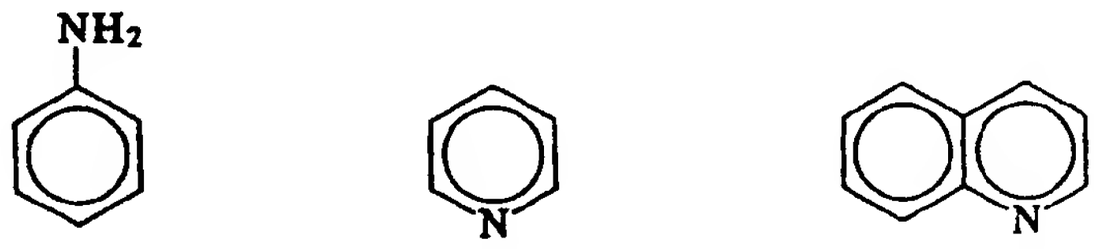
FIG. 2 COAL PRETREATMENT SYSTEM INCORPORATED IN A PYROLYSIS PROCESS UTILIZING CERAMIC BALLS FOR TRANSPORTING HEAT BETWEEN COMPONENTS

The most common form of heterocyclic oxygen is in furan ring systems:

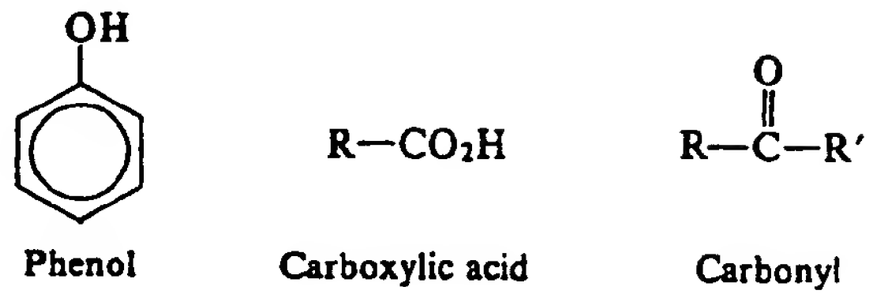


Furan Benzofuran Dibenzofuran

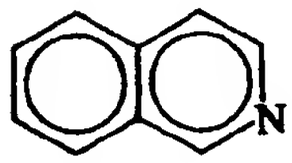




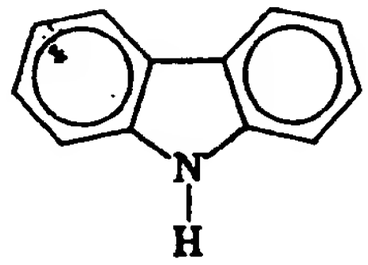
Aniline Pyridine Quinoline



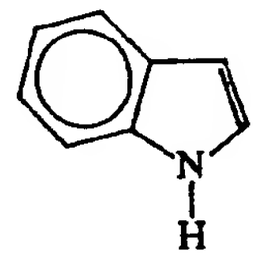
Phenol Carboxylic acid Carbonyl



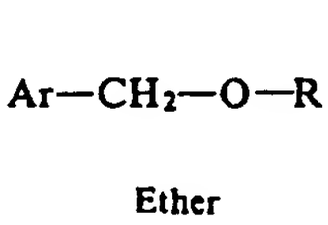
Isoquinoline



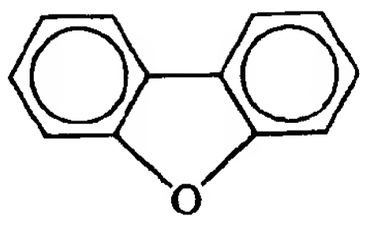
Carbazole



Indole

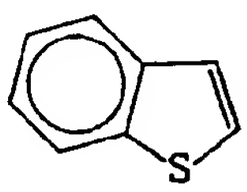


Ether

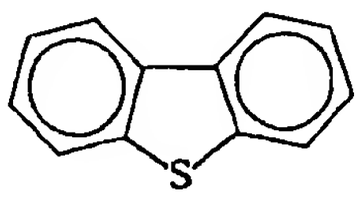


Heterocyclic oxygen

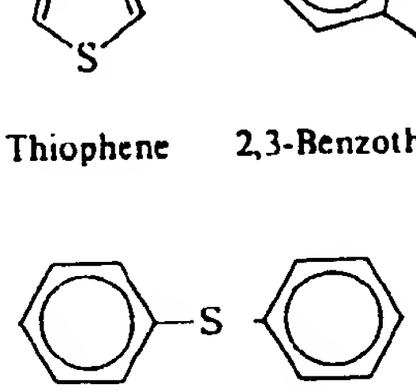
Thiophene



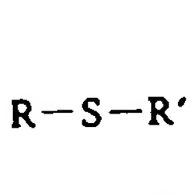
2,3-Benzothiophene



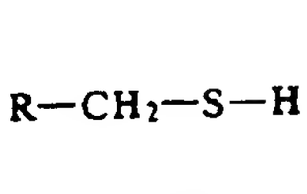
Dibenzothiophene



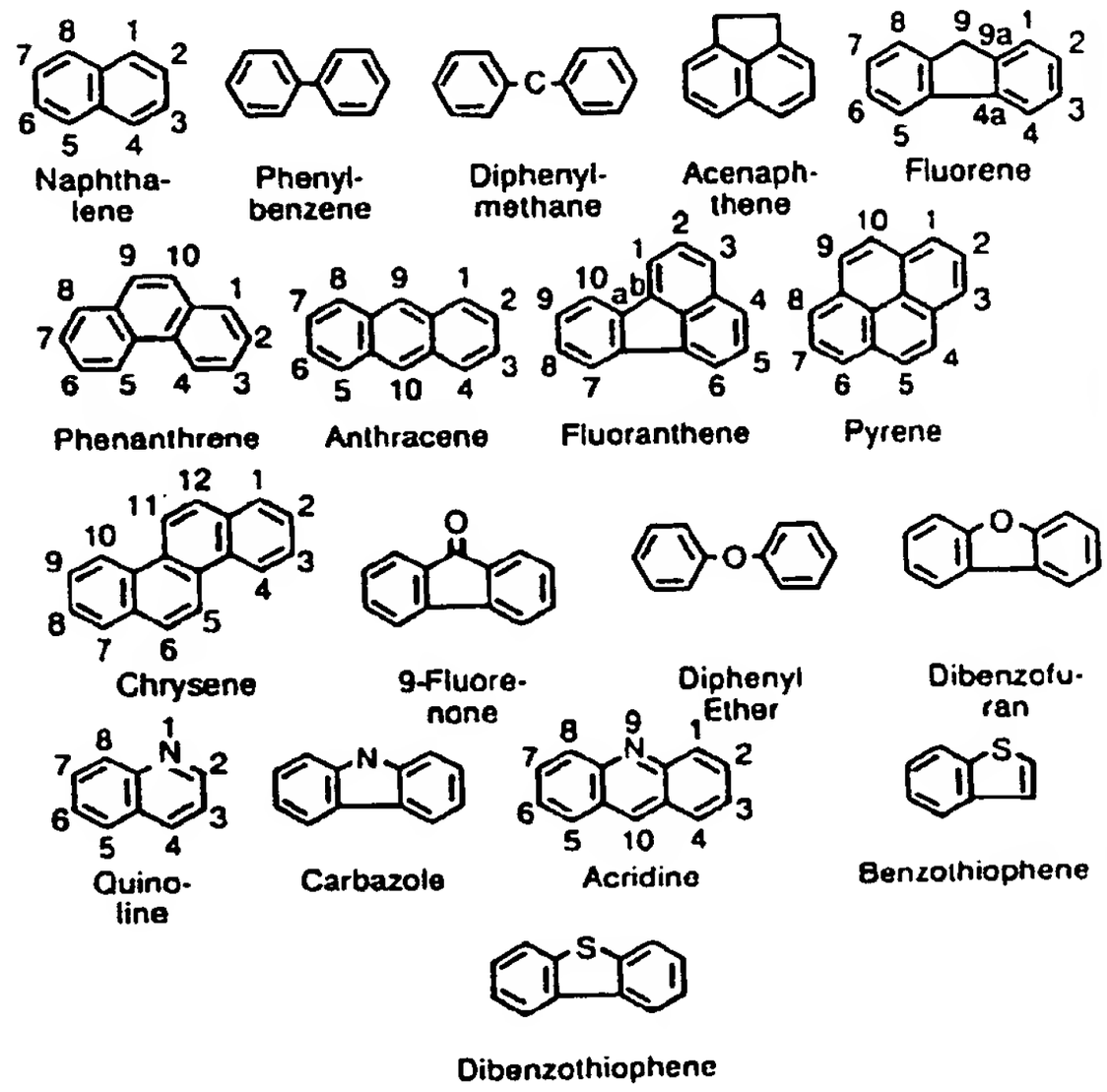
Diphenyl sulfide



Alkyl sulfide



Thiol



Naphthalene Phenylbenzene Diphenylmethane Acenaphthene Fluorene

Phenanthrene Anthracene Fluoranthene Pyrene

Chrysene 9-Fluorenone Diphenyl Ether Dibenzofuran

Quinoline Carbazole Acridine Benzothiophene

Dibenzothiophene

FIG. 3A Structure of selected model compounds.

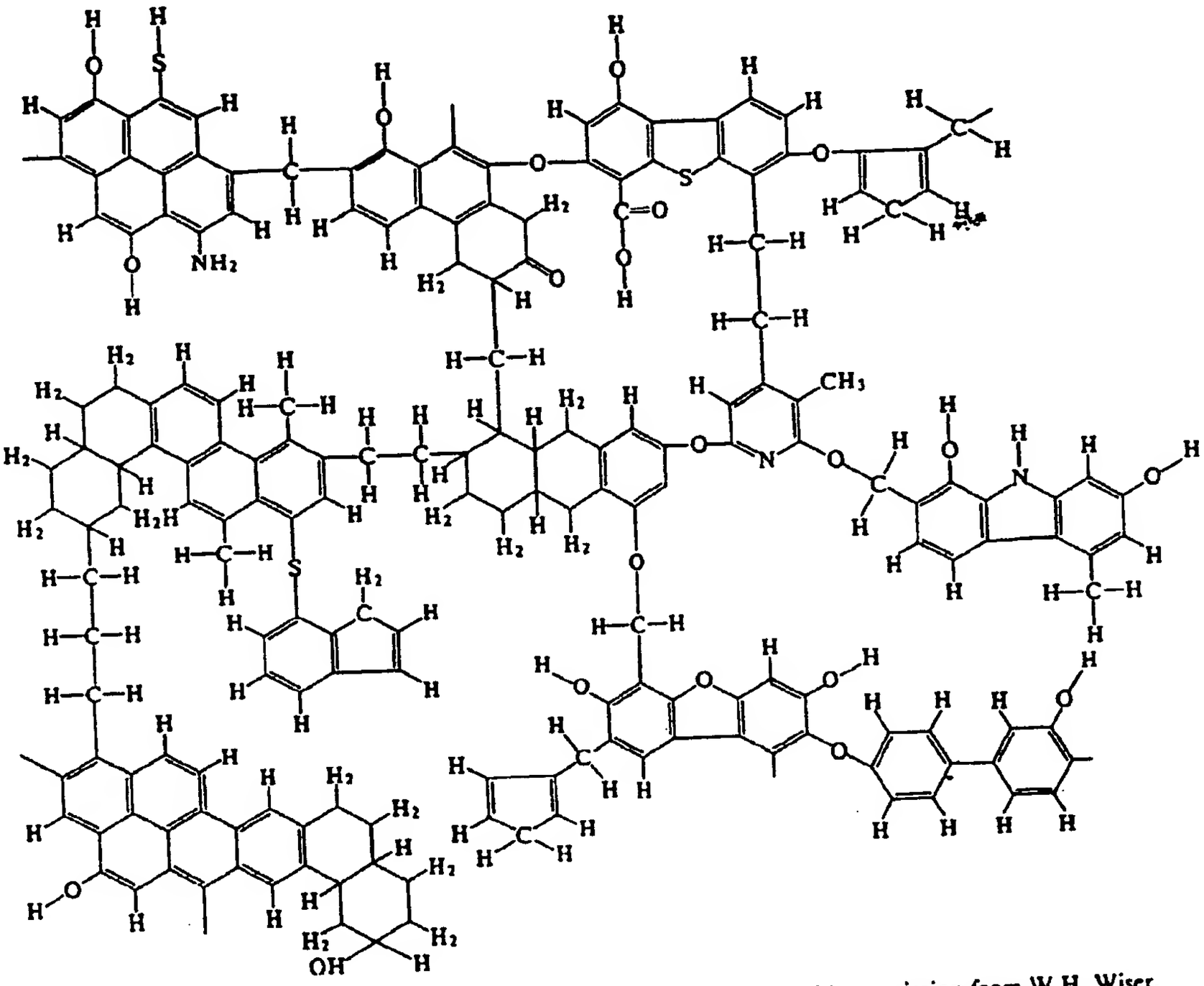


FIG. 3B Wiser model for bituminous coal. (*Source:* Reprinted with permission from W.H. Wiser, "Schematic Representation of Structural Groups and Connecting Bridges in Bituminous Coal," 1978.)

FIG. 4

GLASS SYSTEM PYROLYSIS TESTS

TEST NO. 10 - DEGASSING

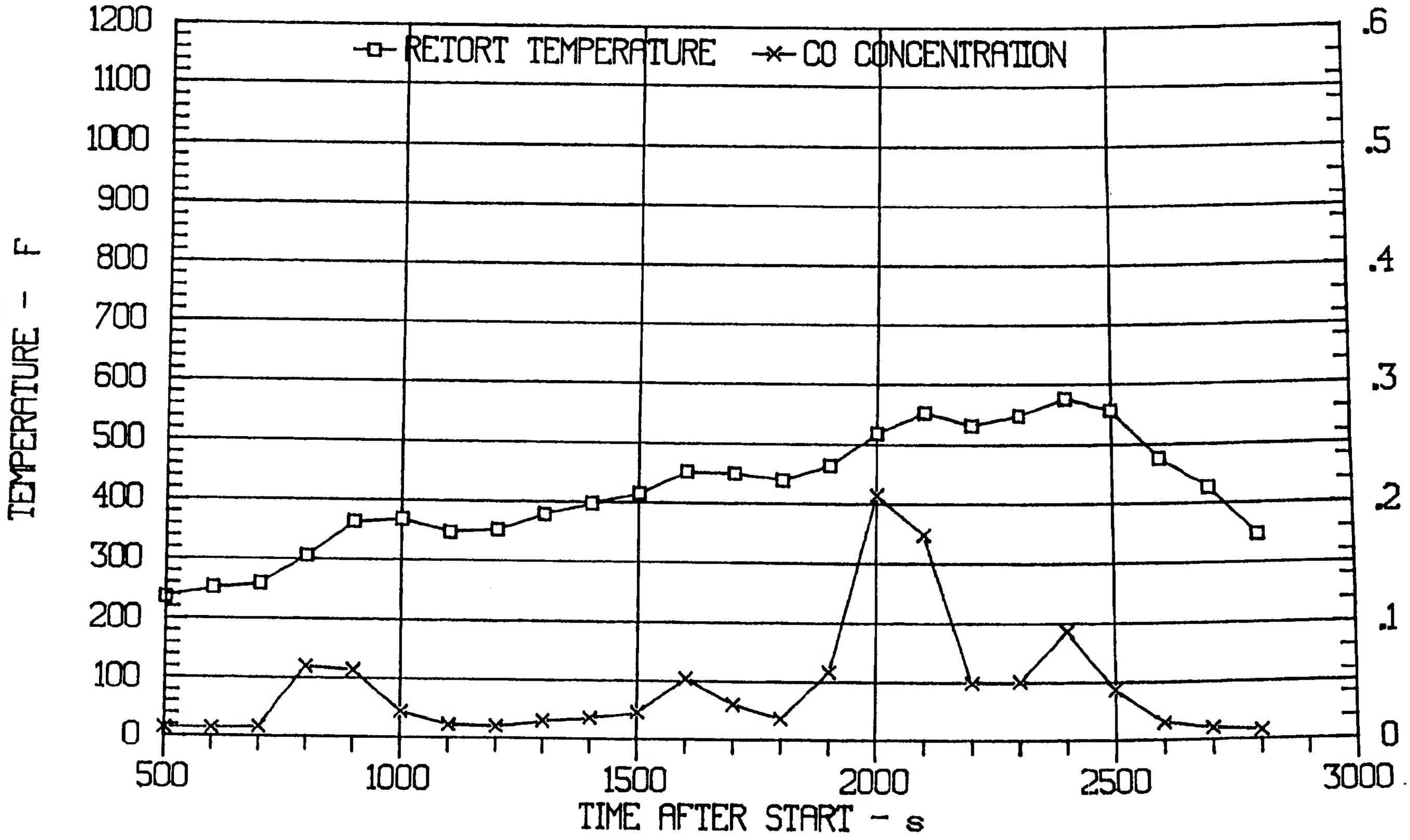
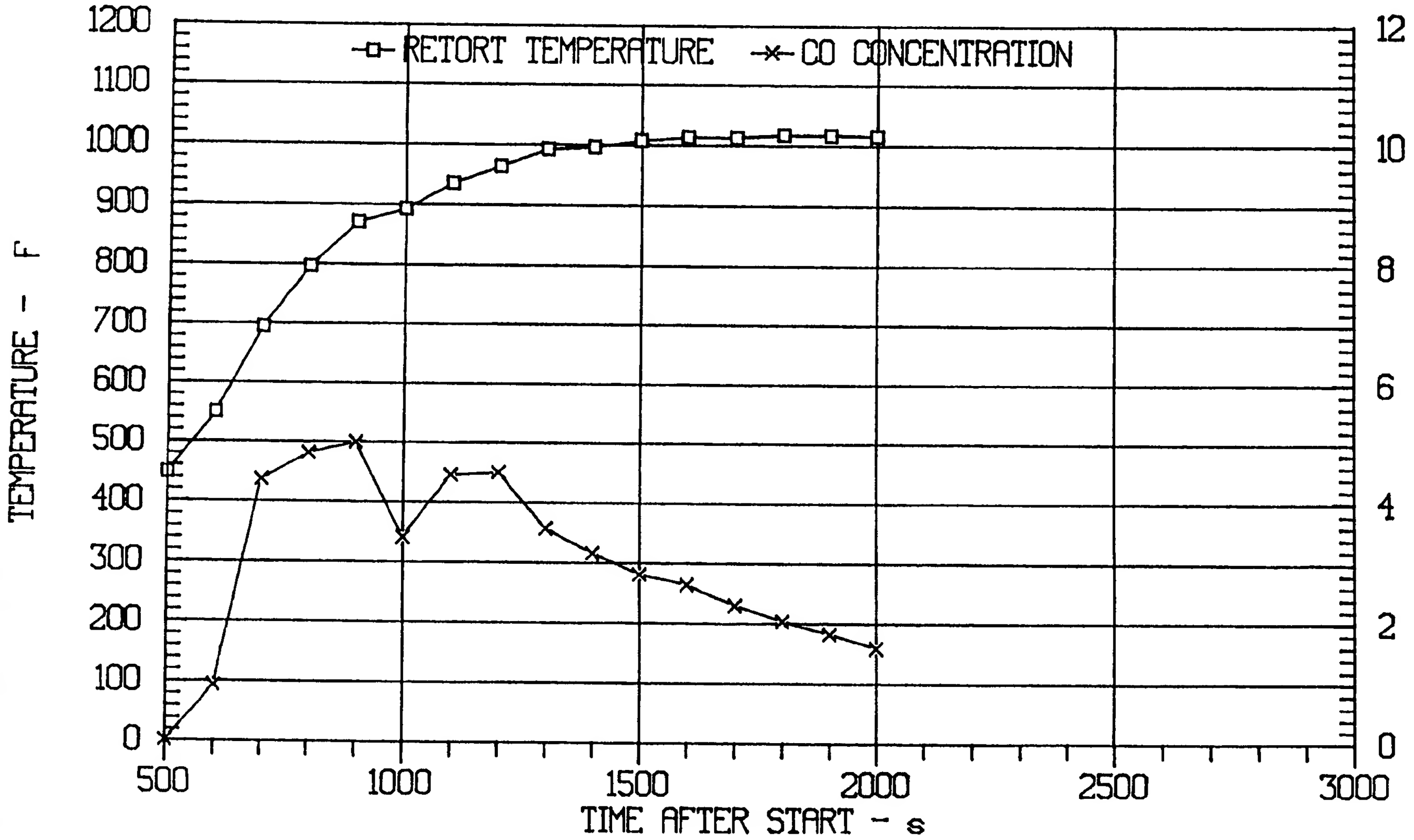


FIG. 5

GLASS SYSTEM PYROLYSIS TESTS

TEST NO. 10 - PYROLYSIS



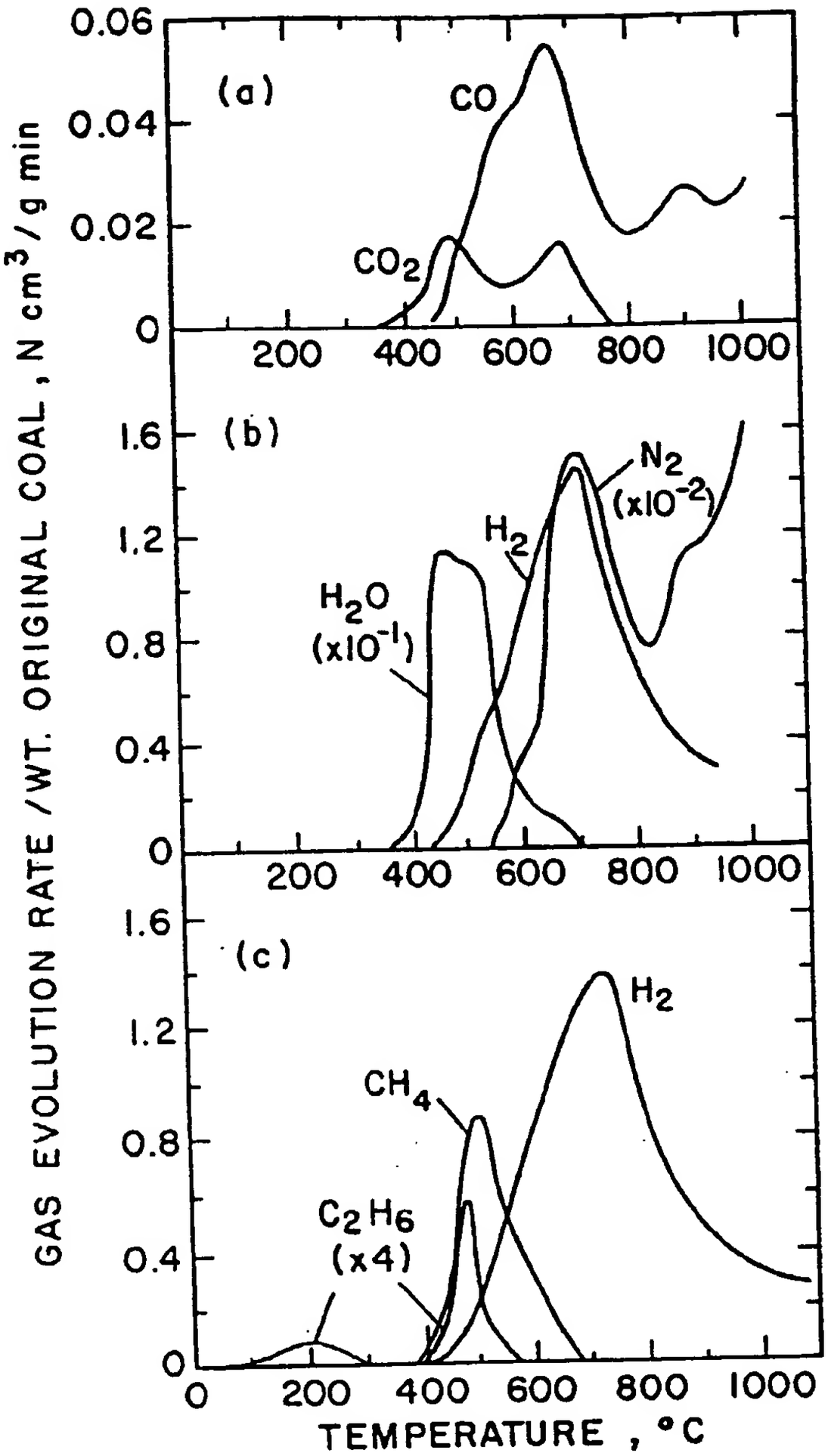


FIG. 6 Variation of Gaseous Species Evolution with Temperature during Coal Pyrolysis at Constant Heating Rate [(a) and (b), data of Klein (1971): Gustav coal, VM = 29 wt. % (MAF): heating rate = 1°C/min. (c), data of Jüntgen and Van Heek (1968): VM = 19.1 wt. %; heating rate = 2°C/min].

FIG. 7 Oxygen concentration in the off-gas and pretreatment bed temperature as functions of time from initation of nitrogen purge.

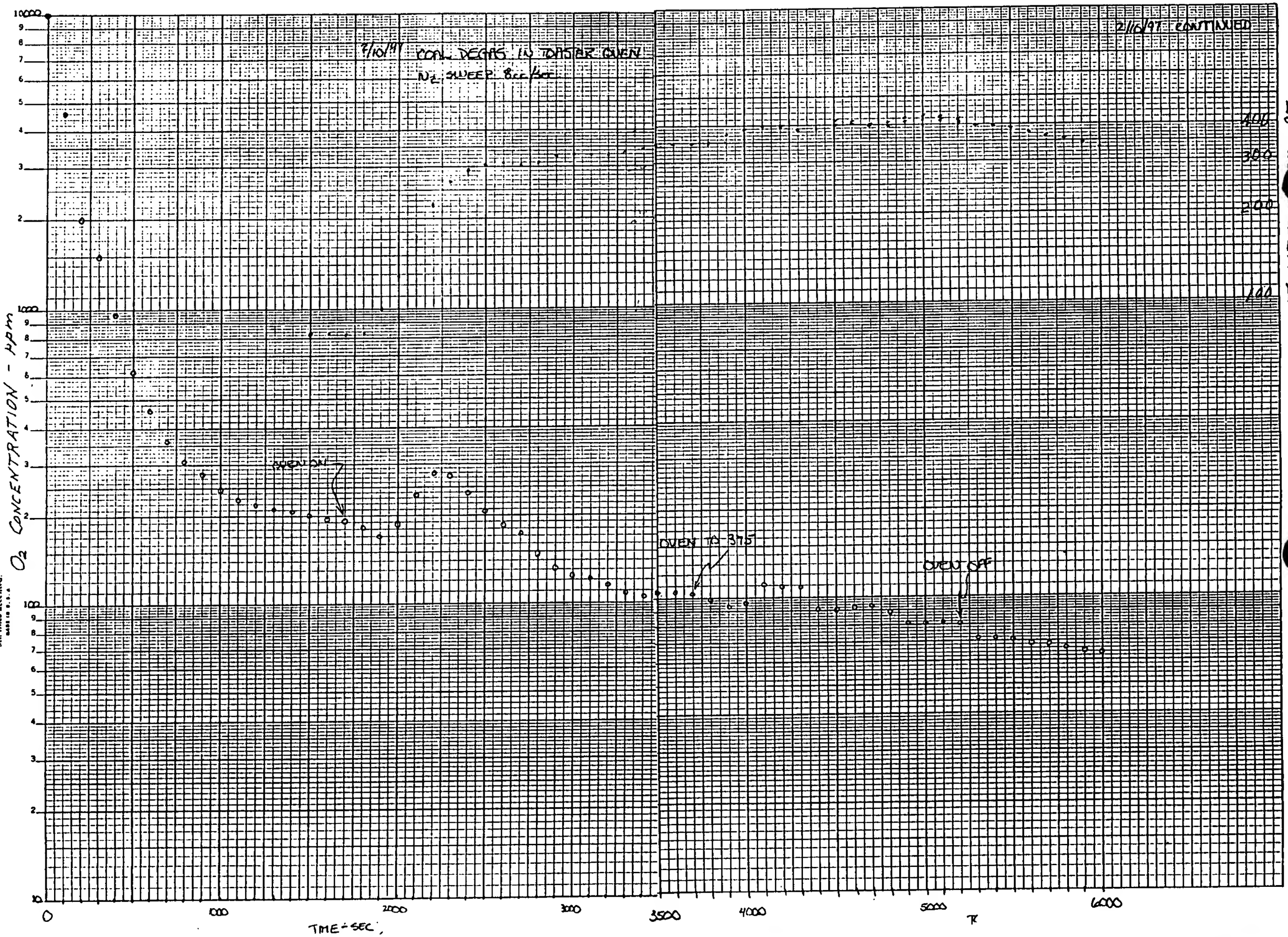


FIG. 8 Mass spectrograph for pyrolysis product liquid after pretreatment at 450°F to remove oxygen, (Courtesy NREL)